Species Diversity, Abundance and Habitat Distribution of Anurans in Mts. Palay-Palay Mataas-na-Gulod Protected Landscape, Luzon Island, Philippines*

Rubie Maranan Causaren[1,2]

KEY WORDS :

Diversity
Species Richness
Density
Microhabitats
Mao Tau
Jackknife1
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VES

ABSTRACT

Mt. Palay-Palay is Cavite's only protected landscape and yet very few herpetological studies have been done in this area. Thus, the study aims to provide robust ecological data on different anuran species so that an effective conservation and management plan could be formulated. Five habitats were sampled using a combination of cruising transect, stratified random strip transect sampling, time-constrained searches, visual encounter survey (VES) and acoustic encounter survey (AES). A total of 1528 individuals belonging to 12 species was recorded from the study area. In addition to previous works, 2 *Platymantis* spp. were new records bringing the total species richness to 16. Of the 16 species, 10 (62.5%) are endemic to the Philippines. Among the species, *Platymantis mimulus* was the most abundant and also had the highest density of 174 frogs ha^{-1}. Among the habitats riparian forests had highest species diversity, Mau Tao and Jackknife1 values which showed dependence of anurans on water. Of the 17 microhabitats, forest floor litter was the most occupied by anurans.

INTRODUCTION

Mts. Palay-Palay Mataas-na-Gulod Protected Landscape (henceforth "Mt. Palay-Palay") is the only protected area in the province of Cavite and considered as an important key biodiversity area (KBA) on Luzon (Conservational International et al. 2006). Very few studies on its herps were conducted and basic taxonomic studies were started by Celis et al. (1996) and Paloma and Panganiban (1997). To date, much of the information on the area's herpetofauna was based on the studies of Causaren (2009) and Lagat (2009). Fourteen anuran species (Causaren 2009) and 36 reptiles (23 lizards, 12 snakes, and 1 turtle; Lagat 2009) are now known from the protected area.

Studies revealed that the most evident threats to the Mt. Palay-Palay's biodiversity were illegal logging, conversion of forest to agricultural lands, slash-and-burn or *kaingin*, charcoal-making, overharvesting, livestock farming, construction of roads, quarrying, poaching and continuous human encroachment (Conservation International 2006; Luyon and Medecilo 2006, Mallari et al. 2001). It is also very alarming to note that in a country-wide study done by Diesmos et al. (2009), results revealed that several anuran species from Mt. Palay-Palay were tested positive for chytridiomycosis, an emerging fungal disease that causes massive population declines and extinction of amphibians worldwide (Stuart et al. 2004, Young et al. 2004, Daszak et al. 2007, Gascon et al. 2007, Pounds et al. 2007, Bain et al. 2008). However, the impacts of these threats on the area's biodiversity are still unknown.

This study provides comprehensive data on the diversity, abundance and habitat distribution of the anurans in the study area. Such data are deemed to be very crucial to future amphibian population studies especially in documenting whether there would be population declines or not. Likewise, the data would be very essential in the formulation and implementation of more effective conservation and management plan for the only protected area in Cavite.

MATERIALS AND METHODS

Study Area: Mts. Palay-Palay, with an area of 3,973.13 ha, is the only remaining protected area in Cavite (Figure 1). It belongs to the three prominent volcanic centers of the Cavite-Batangas Highland. It is bounded by the munici-

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[1] Graduate Studies Department, College of Science and Computer Studies, De La Salle University– Dasmariñas, Dasmariñas City, Cavite, Philippines
[2] Correspondence: mcausaren@dlsud.edu.ph.

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palities of Ternate and Maragondon (in Cavite Province) and Nasugbu (in Batangas Province) with coordinates of 120º39' east longitude and 14°14' north latitude. On the north, it is bordered by Manila Bay, in the west by the China Sea and in the southeast by Mts. Cariliao and Batulao. It is in a range of low hills with three peaks, Mataas na Gulod (622 masl), Pico de Loro (595 masl), and Palay-Palay (predominantly timberland) - being the highest at 648 meters above sea level (Zanoria 1991, DENR 1992).

The area is covered with secondary growth forest (62.5 % cover) on limestone (Mallari et al. 2001). Its vegetation is a mixture of molave and dipterocarp species (DENR, 1992). Some portions are patches of open grassland, brush, and cogonal areas which were targeted for reforestation activities (PAWB, 1989). There are also arable land, small settlements and rural gardens, and some “kaingin” (Mallari et al. 2001). The area is categorized under climatic type I with two pronounced seasons: dry from November to April and wet throughout the rest of the year (DENR, 1992). The average annual rainfall in the area is 2000mm/annum with an average humidity of 57%.

Habitat Classification: The habitats were arbitrarily classified in order to determine the number of transects to be sampled per fragment. The classification of habitats was primarily based on how the habitat developed and classification based on tree species composition was only secondary. Based on the context of this study, ’agroforest’ was defined as a habitat that was previously subjected to land-use change (*e.g.,* illegal logging, overharvesting, slash-and-burn (*kaingin*)) and other farming activities but became reforested due to incorporation of multifunctional trees into agricultural systems. ‘Mixed forest’ was defined as a habitat that was also previously subjected to land-use change (*i.e.,* illegal logging) but both natural and artificial regeneration were carried out in the same area, with deliberate silvicultural assistance from man. These were usually the product of tree planting activities done by Department of Environment and Natural Resources (DENR), non-government organizations (NGOs), and corporations. A ‘natural forest’ was defined as a habitat that originated from an original forest and consisted of natural immigrant tree species and strains that have spontaneously regenerated without interference from man. A ‘riparian forest’ was defined as a habitat with trees and shrubs located adjacent to streams/rivers/creeks. A ‘grassland’ was defined as a habitat where the vegetation was dominated by grasses and other herbaceous or non-woody plants. Grasslands were usually parts of the forest edges of the fragments.

Number and Distribution of Transects: Twenty (20) standardized 100 x 10 m strip transects were sampled during the dry season and another set of 20 transects were sampled during the wet season, giving a total of 40 transects. Research design followed stratified random sampling (Diesmos, 2008) in which strip transects were randomly placed (at least 100 m apart) in all representative habitats. Up to 2 strip transects were sampled each night throughout the study and sampling began immediately after sunset. Night-time sampling was done primarily because anurans are nocturnal or active at night.

Field Methods: Field work was conducted from February 2010 to September 2010 using various standard methods such as strip transect sampling, time-constrained searches, visual encounter survey (VES), and acoustic encounter survey (AES) (adapted and modified from Crump and Scott, 1994; Heyer et al., 1994; Alcala et al., 2004; Diesmos, 2008). Visual encounter surveys were conducted by walking through a 100 X 10 m transect (transect sampling) for a prescribed time of two hours (time-constrained searches), visually searching for anurans. The transect line was marked at 10-m intervals with numbered fluorescent flagging tapes labeled according to the transect number and point. For each transect, two hours were spent by the same four persons to sample all accessible microhabitats confined within. Microhabitats are specific areas within a community or habitat occupied by certain organisms because of microdifferences in moisture, light, and other conditions like availability of nutrients, protection from predator, and possibility of mating. Examples of microhabitats were forest floor litter, tree holes, rock crevices, spaces between buttresses of trees, forest shrubs, and axils of palms, epiphytes, tree ferns, and aerial ferns. Prior to sampling, the first two points (points 0 and 1; with a distance of 10 m) were marked and 12 minutes were spent in sampling this particular portion of the transect, after which all anuran individuals whether seen, heard, or caught were recorded. This was done repeatedly until all the succeeding portions of the transect were sampled. Point sampling was done to minimize disturbance within the transect. The total field sampling effort was 160 man-days (80 man-days for each season).

VES was supplemented with acoustic encounter survey where anuran species were identified by their calls (aural identification). Male advertisement calls have been used as a taxonomic character in the identification of frogs (see, e.g., Brown and Alcala, 1986; Brown et al., 1997a; Alcala and Brown, 1998). The number of anurans encountered (by both visual and aural methods) was recorded.

All captured frogs were processed and identified to species level, measured (mm), classified according to sex and age, and released at/near sites of capture. Nomenclature of anurans followed Alcala (1986), Brown et al. (1996), Brown et al. (1997a, b, c), Alcala and Brown (1998), Diesmos (1998, 1999, 2008), and Frost (2010).

Data Analysis: The Shannon–Wiener index (H′; Shannon, 1948) was used to represent anuran species diversity (Dixo and Martins, 2008; Diesmos, 2008; Magurran, 2004). Species richness is the most commonly used biodiversity

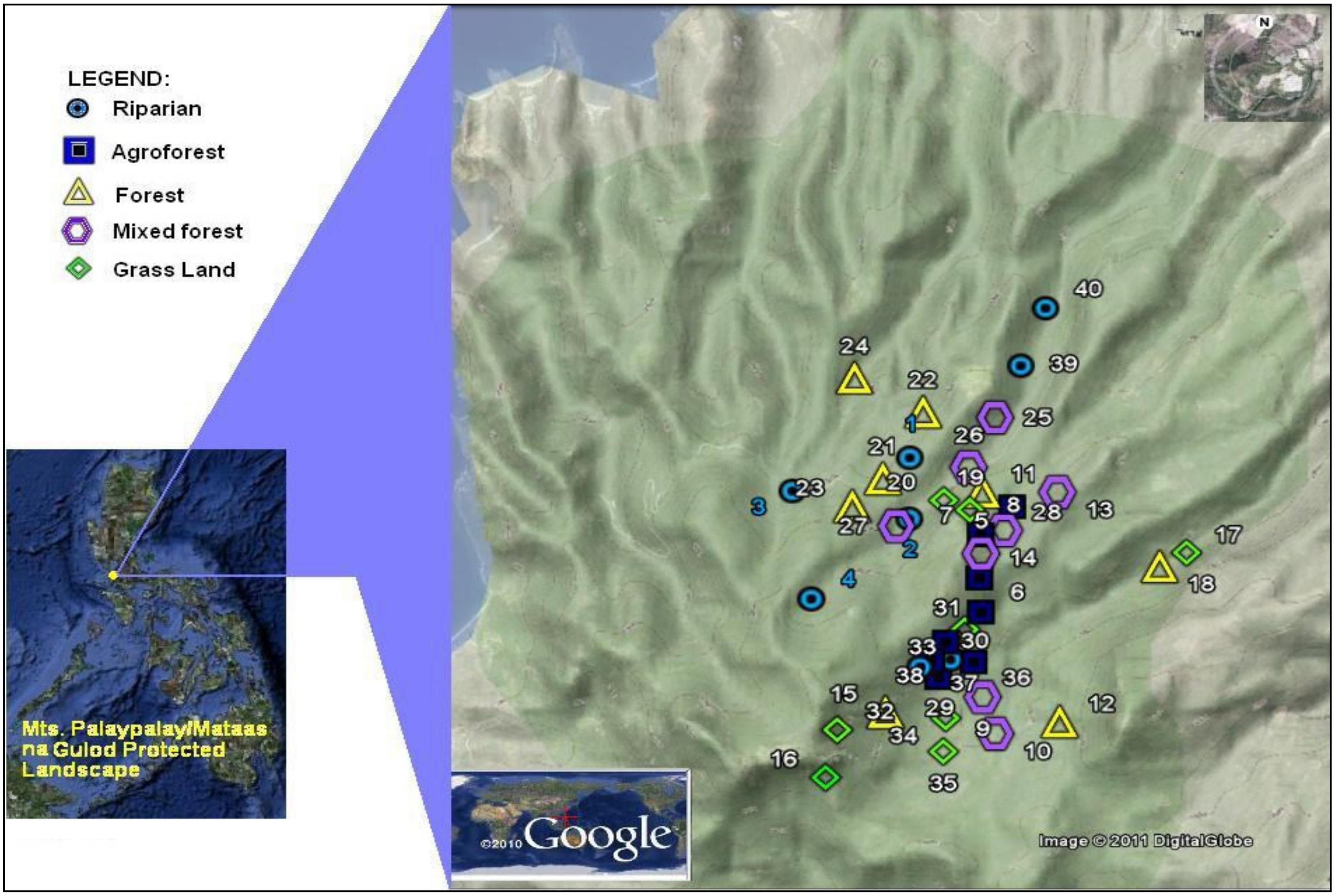

Figure 1. Map of Mt. Palay-Palay showing the distribution of the different transect points which represented different habitats. Modified from Google Earth 2011.

indicator in conservation and ecological research (Gaston, 1996). Species richness of each forest fragment was determined by using the estimator Jackknife1 (Jack1; Stigler, 1977) which is considered to be a robust estimator of species richness (Mallari, 2009; Hortal *et al.*, 2006; Veith *et al.*, 2004). In order to describe the relationship between sampling effort and sampling success, rarefaction (Mao Tau) analysis (Gotelli and Colwell, 2001) was employed (Mallari, 2009; Diesmos, 2008; Loehle *et al.*, 2005). This was done to determine the number of species that were overlooked due to incomplete detection. Rarefaction estimates the number of species from a given sample of point transects based on multiple random sampling and would show if the fragments have been sampled representatively. Species richness estimates and accumulation curves (sample-based rarefaction curves) were calculated (500 randomizations without replacement) using the EstimateS v.8.2 (Colwell, 2009). Data from non-random searches/overall collection were only considered to note overall species diversity but were not used in the computation of species richness and abundance. Species relative abundance was computed by getting the quotient of number of individuals of a species and total number of ndividuals multiplied by 100. Density, defined as the number of individuals per unit area (number/ha), was computed by getting the quotient of the number of individuals of a species by 4 ha (40 transects X 1,000 m^2=40,000m^2=4 ha).

RESULTS AND DISCUSSION

Species Richness and Zoogeography: A total of 1,528 individuals belonging to 12 species (in 7 genera) was recorded from the study area (Table 1, Figure 2). Ten of these 12 species were also recorded from previous studies (Causaren 2009, Maranan 1999) while 2 species, *Platymantis luzonensis* and *Platymantis* sp., are new records. Four species (*Fejervarya vittigera*, *Kaloula picta*, *Hoplobatrachus chinensis*, and *Hylarana erythraea*) were previously recorded from lower elevations in the immediate vicinities of the protected area (Causaren 2009, Maranan 1999) bringing the total number of anuran species in Mt. Palay-Palay to 16.

Mt. Palay-Palay is now considered an important area not only

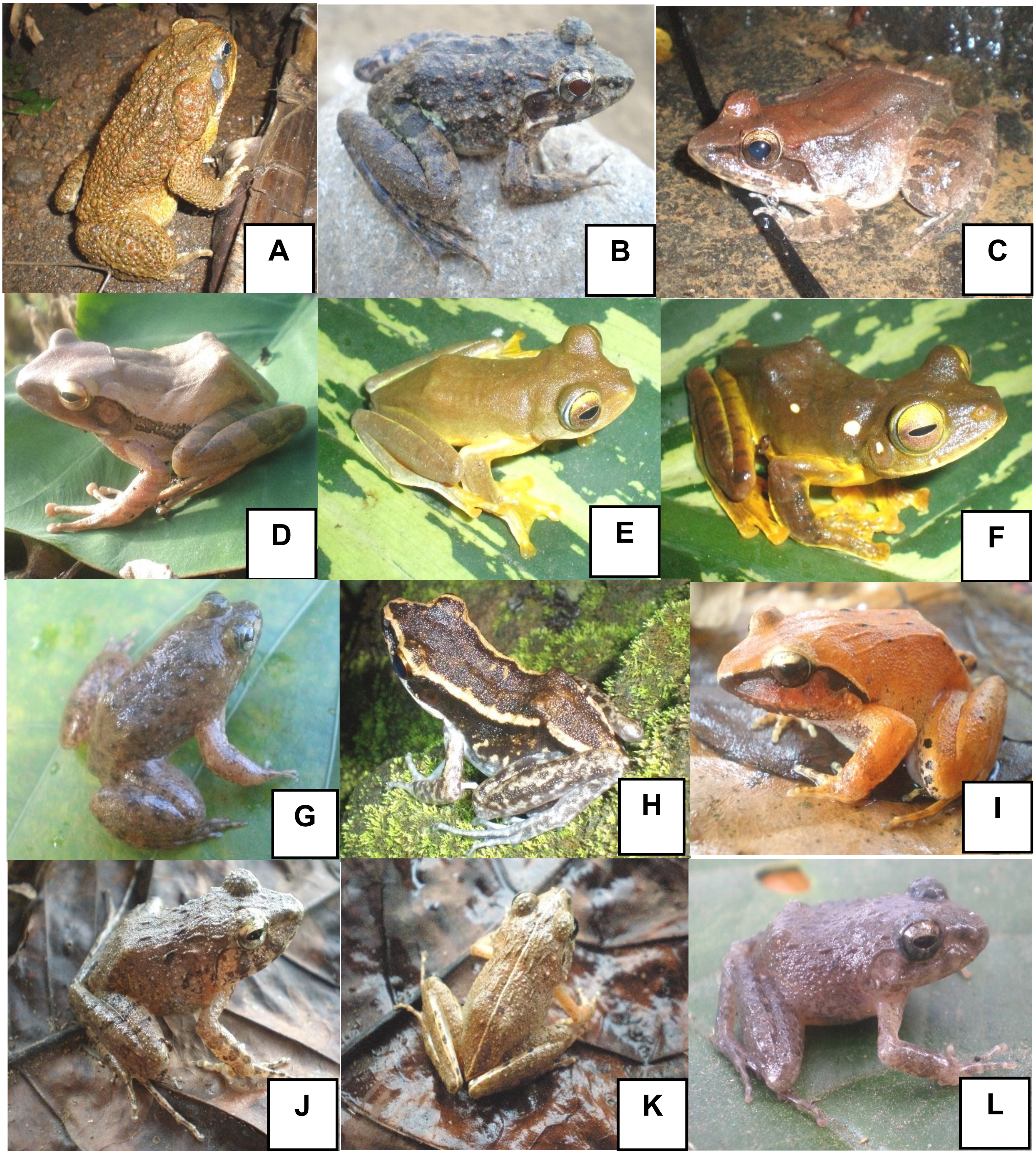

Figure 2. Some anurans of Mt. Palay-Palay. A. *Rhinella marina*, B. *Limnonectes macrocephalus*, C. *Limnonectes woodworthi,* D. *Polypedates leucomystax* (female), E. *Rhacophorus pardalis* (female), F. *Rhacophorus pardalis* (male), G. *Occidozyga laevis*, H. *Pulchrana similis*. I. *Platymantis corrugatus*, J. *Platymantis dorsalis*, K. *Platymantis mimulus*, and L. *Platymantis* sp.. (Photos by Rubie Maranan Causaren)

Table 1. Summary information on life history and some ecological traits of the anurans from Mt. Palay-Palay. Ecological status (in boldface = Philippine endemic, ** = Luzon endemic, + = introduced); mode of life, *ML* (1 = terrestrial, 2 = aquatic and terrestrial, 3 = arboreal, 4 = semi-arboreal) was based from Alcala and Brown (1998) and Diesmos (1998, 1999, 2008); habitat, *HA* (1 = agroforest, 2 = forest, 3 = grassland, 4 = mixed forest, 5 = riparian forest) was based from this study; and red list category, *RL* (1 = least concern, 2 = near threatened) was based from IUCN (2010).

Species	ML	HA	RL
BUFONIDAE			
Rhinella marina+ (Linnaeus, 1758)	1	3,5	1
RANIDAE			
Limnonectes macrocephalus**(Inger, 1954)	2	2,3,4,5	2
Limnonectes woodworthi** (Taylor, 1923)	2	1,2,3,4,5	1
Occidozyga laevis (Günther, 1858)	2	1,2,3,4,5	1
Platymantis corrugatus (Duméril, 1853)	1	1,2,4,5	1
Platymantis dorsalis (Duméril, 1853)	1	1,2,4,5	1
Platymantis luzonensis** Brown, Alcala, Diesmos, and Alcala, 1997	3	5	2
Platymantis mimulus** Brown, Alcala, and Diesmos, 1997	1	1,2,3,4,5	2
***Platymantis* sp.**	1	5	-
Pulchrana similis**(Günther, 1873)	2	4,5	2
RHACOPHORIDAE			
Polypedates leucomystax (Gravenhorst, 1829)	3	1,2,3,4,5	1
Rhacophorus pardalis Günther, 1859	3	1,2,4,5	1

for anurans but also for reptiles (Lagat 2009, 1999) and birds (Mallari et al. 2001). Ten of the 16 species (62.5%) are endemic to the Philippines. Although endemism was high, richness was still lower compared with that of other mountains in southeastern Luzon. A trend of increasing species richness in areas with high amount of moisture or rainfall has been documented in amphibian communities from other parts of the world (Heatwole 1982, Duellman and Trueb 1994, Diesmos 1998). As noted by Diesmos 1998, species diversity in southern Luzon Island increases in an eastward trend since western regions of the country receive the lowest amount of annual rainfall (Salita 1974). Additional data on anuran species richness of four mountains on Luzon would prove this (Causaren 2009; Diesmos 1999, 1998; Maranan 1999; Brown RM et al. 1996). Diversity increased in an eastward trend: Zambales Mountains with 13 species (9 endemics), Mt. Palay-Palay with 16 species (10 endemics), Mt. Maquiling with 22 species (14 endemics) and Mt. Banahao with 25 species (17 endemics). Mt. Palay-Palay and the Zambales Mountains are both situated at the western side of Luzon. Thus, if these areas receive the lowest amount of annual rainfall, species richness is lower compared with the other two mountains situated on the eastern side of the country. The increase in species richness was exhibited significantly by genus *Platymantis*. Only 3 species were recorded from the Zambales Mountains (Brown et al. 1996), 5 from the study area, 5 in Mt. Maquiling and 8 in the Banahao massif (Diesmos 1999, 1998). It is noted further that the diversity of *Platymantis* tends to increase from west to east in areas with high amounts of moisture.

Abundance and Density: Among the species, *P. mimulus* was the most abundant representing 45.6% of the sampled population of anurans (Table 2). It was followed by *P. dorsalis* and three aquatic species (*P. similis*, *L. woodworthi*, and *O. laevis*) while the least abundant species were *P. luzonensis* and *Platymantis* sp.. The abundance of the terrestrial *Platymantis* spp. could be because of the availability of suitable habitats and microhabitats and their unique reproductive mode. Being direct terrestrial developers, these frogs do not require streams or standing water to reproduce allowing them to thrive in terrestrial habitats which are uninhabitable for other anuran species. The abundance of aquatic species could also be attributed to the availability of water throughout the year. Estimates of the density of *Platymantis* sp. and *P. luzonensis* could be negligible due to insufficient data.

P. mimulus also had the highest density of 174 frogs ha^{-1} followed by *P. dorsalis* with a density of 48 frogs ha^{-1} (Table 2). These species were followed by the same three species: *P. similis*, *L. woodworthi*, and *O. laevis* with densities of 42.75 frogs ha^{-1}, 32.75 frogs ha^{-1}, and 30 frogs ha^{-1}, respectively. Again, the large densities of these species could be attributed to their reproductive success due to the availability of suitable habitats.

Table 2. Density and relative abundance of anurans.

SPECIES	No. of individuals observed	Relative Abundance	Density (per ha)	Relative Density
Limnonectes macrocephalus	21	1.37	5.25	1.37
Limnonectes woodworthi	131	8.57	32.75	8.57
Occidozyga laevis	128	8.38	32	8.38
Platymantis corrugatus	57	3.73	14.25	3.73
Platymantis dorsalis	193	12.63	48.25	12.63
Platymantis luzonensis	1	0.07	0.25	0.07
Platymantis mimulus	697	45.62	174.25	45.62
Platymantis sp.	1	0.07	0.25	0.07
Polypedates leucomystax	70	4.58	17.5	4.58
Pulchrana similis	171	11.19	42.75	11.19
Rhacophorus pardalis	58	3.80	14.5	3.80
Total	1528	100.00	382	100.00

Table 3. Species richness estimates (± SE) and diversity (H') in different habitats (based on non- parametric estimators in EstimateS). Shown also were the number of species observed (Mao Tau) in each habitat type and the survey effort measured as to the number of transects per habitat.

Habitat	Survey effort (# of transects)	Individuals observed	Species observed (Mao Tau) ± Standard error	Species richness (Jackknife 1) ± Standard error	Proportion detected	Species diversity (Shannon H' mean)
Agroforest	8	157	6 ± 1.16	7.75 ± 1.75	0.77	1.52
Natural Forest	8	281	7 ± 0.46	7.88 ± 0.88	0.89	0.96
Grassland	8	37	4 ± 0.85	5.75 ± 1.15	0.70	0.89
Mixed	8	287	9 ± 0.38	9.88 ± 0.88	0.91	1.68
Riparian	8	766	11 ± 0.90	12.75 ± 1.15	0.86	1.80
Overall	40	1528	11 ± 0.95	12.95 ± 1.36	0.85	1.76

Note: *R. marina* was not included in the computation since it was found outside of the transect.

Table 4. The habitat distribution of the anurans in the study area.

	Total	HABITAT TYPES				
SPECIES	**Sample**	**Riparian Forest**	**Agroforest**	**Mixed Forest**	**Forest**	**Grassland**
Limnonectes macrocephalus	21	14		5	1	1
Limnonectes woodworthi	131	72	20	29	9	1
Occidozyga laevis	128	47	33	19	8	21
Platymantis corrugatus	57	28		10	19	
Platymantis dorsalis	193	99	24	37	33	
Platymantis luzonensis	1	1				
Platymantis mimulus	697	290	69	132	206	
Platymantis sp.	1	1				
Polypedates leucomystax	70	6	5	40	5	14
Pulchrana similis	171	162		9		
Rhacophorus pardalis	58	46	6	6		
Total	1528	766	157	287	281	37
Percentage		50.1	10.3	18.8	18.4	2.4

Table 5. Microhabitat distribution patterns of the anurans in the study area. Samples and degree of occurrence of species per microhabitat (expressed in percentage, in parenthesis) are given.

SPECIES	MICROHABITAT TYPES								
	Total Sample	Aroid	Bamboo	Banana plants	Forest floor litter	Tree branch	Tree stem/ trunk	Buttress	Crevice
Limnonectes macrocephalus	21				1 (4.8)				
Limnonectes woodworthi	126				20 (15.87)				
Occidozyga laevis	125				6 (4.8)				
Platymantis corrugatus	55				48 (87.3)			4 (7.3)	
Platymantis dorsalis	185				148 (80)			8 (4.5)	
Platymantis luzonensis	1					1 (100)			
Platymantis mimulus	661	1 (0.15)	2 (0.3)		510 (77)	1 (0.15)	2 (0.3)	26 (4)	4 (0.6)
Platymantis sp.	1				1 (100)				
Polypedates leucomystax	70		20 (28.57)	3 (4.3)	1 (1.43)	3 (4.3)	2 (2.86)		
Pulchrana similis	168	1 (0.5)			1 (0.5)			5 (3)	
Rhacophorus pardalis	58	21 (36.2)			1 (1.73)	3 (5.17)	14 (24.14)		
Total	1471								

SPECIES	MICROHABITAT TYPES								
	Driftwood Crevice	Fern	Puddles	Rattan leaf	Rocks	Shrubs	Soil	Twigs	Water
Limnonectes macrocephalus		1 (4.8)			11 (52.4)		4 (19.0)		4 (19.0)
Limnonectes woodworthi			2 (1.58)		79 (62.7)				25 (19.85)
Occidozyga laevis			14 (11.2)		11 (8.8)				94 (75.2)
Platymantis corrugatus					3 (5.4)				
Platymantis dorsalis					20 (10.8)	2 (1)	6 (3.2)	1 (0.5)	
Platymantis luzonensis									
Platymantis mimulus	4 (0.6)	4 (0.6)		1 (0.15)	33 (5)	30 (4.5)	10 (1.5)	32 (5)	1 (0.15)
Platymantis sp.									
Polypedates leucomystax					4 (5.7)	31 (44.3)	5 (7.14)	1 (1.40)	
Pulchrana similis		3 (2)			140 (83)		10 (6)	5 (3)	3 (2)
Rhacophorus pardalis					4 (6.9)	14 (24.14)			1 (1.73)

Habitat Distribution: The anuran assemblage of the study area had an overall H' value of 1.76 (Table 3) indicating that the study area had high species diversity. Comparing the five habitats, riparian forests had the highest H' value of 1.80 which was even higher than the overall H' value. This could be expected since most of the anurans were very dependent on water for their survival. On the other hand, grasslands had the lowest diversity value of 0.89. This could be attributed to the unavailability of different microhabitats. A comparison of the expected number of species observed (Mao Tau) to the species richness (Jackknife1) indicated that ca. 77-91% of the anuran species were detected from the different habitats (Table 3). This also showed that sampling effort was enough to detect almost all possible species from different habitats. From among the habiats, Mao Tau, and Jackknife1 were highest in riparian forest followed by mixed forest and lowest in grassland.

Among the individuals/samples observed 50% occurred in the riparian forest while both the forest and mixed forest housed 18% of the sampled population (Table 4). The grassland again housed the least number of individuals, only 2.4%. Among the species, individuals of *P. mimulus* had the highest number in all habitats occupied except grassland.

The occurrence of the majority of individuals in riparian forests indicated dependence of anurans on water for their survival. The occurrence of the majority of individuals in riparian forests, mixed forests, and forest areas could also be attributed to the diversity of microhabitats in these habitats: 13 microhabitats in both forest and riparian forests and 14 microhabitats in mixed forests. Only 5 and 8 microhabitats were found in grassland and agroforest, respectively .

Microhabitat Distribution: Seventeen (17) microhabitats were identified (Table 5). A large proportion of anurans occurred in forest floor litter (50.1%) followed by rocks (20.73%), with 10 and 9 species respectively. Among the inhabitants of forest floor litter, *Platymantis* spp. had the highest occurrence with *P. mimulus* with the highest degree of occurrence of 69% followed by *P. dorsalis* with 20%. All *Platymantis* spp. recorded from the study area were forest floor dwellers except *P. luzonensis*. Among the *Platymantis* spp., *P. mimulus* had the widest microhabitat distribution occupying 15 (88%) of the 17 microhabitats. This showed that *P. mimulus* was the most successful in adapting to its environment making it also the most abundant among the anuran species. Aside from the forest floor litter, *P. dorsalis* occupied another 5 microhabitats which were tree buttresses, rocks, shrubs, soil, and twigs. *P. corrugatus*, on the other hand, occupied only 3 microhabitats which were forest floor litter, tree buttress, and rocks. The previous information conform to the knowledge that all known species of Philippine *Platymantis* were predominantly terrestrial, inhabiting wet/moist forest floor and arboreal sites in closed-canopy forest, and are considered direct developers (without passing the tadpole stage) (Alcala and Brown 1998).

Among those anuran species inhabiting streams, *P. similis* and *L. woodworthi* had the highest degree of occurrence with 45.9% and 25.9% respectively. *P. similis* were usually found forming small groups and called in choruses atop rocks. This species also occurred on top of aroid plants, in forest floor litter, on tree buttresses, on ferns, on twigs, in water, and on soil near riverbanks. *L. woodworthi* also occupied the forest floor litter, puddles, and were also found in water. A majority of *L. macrocephalus* individuals also occupied rocks but were also observed in the forest floor litter, on fern, soil, and in water.

Among the water inhabitants, *O. laevis* had the highest degree of occurrence of 73%. Individuals of this species were usually found submerged in water only with their snout exposed to the air. Some individuals also occurred in the forest floor litter, in temporary puddles, and on rocks.

Among the arboreal/semi-arboreal species, *P. leucomystax* occurred in 9 microhabitats mainly on shrubs and bamboo. It was also the only species found on banana plants. Most individuals of *R. pardalis*, on the other hand, were found on aroid plants, on shrubs, and on branches of trees at the edge of water bodies. Oftentimes, these species were seen inhabiting the same microhabitat.

CONCLUSIONS

Sixteen (16) anuran species were recorded for Mt. Palay-Palay and its immediate vicinities. Endemism is high at 62.5% with 10 of the 16 species endemic to the Philippines. Among the species, *P. mimulus* was the most abundant representing 45.6% of the total population of anurans. It also had the highest density of 174 frogs ha^{-1}. The abundance of the terrestrial *Platymantis* spp. could be because of the availability of suitable habitats and microhabitats and their unique reproductive mode (being direct terrestrial developers). Five habitats and 17 microhabitats were identified. Riparian forests proved to be the most diverse among habitats while 50% of the anurans preferred forest floor litter as microhabitat.

RECOMMENDATIONS

In the Philippines, the most immediate and clear threat to the fauna is habitat destruction resulting to the clearance and fragmentation of lowland dipterocarp forest and lower montane forest (Diesmos et al. 2002). Clearance and fragmentation is said to affect 85% of the country's fauna. Mt.

Palay-Palay is not spared from this fate. If these threats persist, they will definitely make a negative impact on the flora and fauna of this protected area. In light of the data presented, it is the hope of this study to provide a more accurate assessment on the incidence, abundance, population density, and habitat distribution of the anurans of the protected area so that more effective management and conservation plans be made. There is an urgent need for extensive faunal inventories, ecological and life history studies, and habitat fragmentation effects on populations (both flora and fauna) especially for the rare and endemic species of the park. It is also the hope of this study to encourage cooperation among the DENR, LGUs, NGOs, tenured migrants and the community to altogether protect the only remaining protected area in Cavite.

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